The Must Haves for a Sustainable 2050

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MAHB
MILLENNIUM ALLIANCE FOR HUMANITY & THE BIOSPHERE

Global civil society combining forces to confront the degradation of our life support systems and the interconnections among the greatest threats to human well-being…
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Introduction

This report describes an 18-month World Business Council for Sustainable Development (WBCSD) project, Vision 2050. The vision was formed by a technique of backcasting past events, to evaluate the plausibility of reaching a reasonably sustainable world in 2050. The team comprised of 29 senior strategists representing 29 diverse companies. Its leadership included two of the co-authors of the present report: Idar Kreutzer, CEO of Storebrand, a large Norwegian financial services company. and Mohammad Zaidi, who was until the latter part of 2011, the Executive Vice President and Chief Technical Officer of Alcoa, one of the world's leading aluminum companies. They were joined by two CEOs from WBCSD member companies, Price Waterhouse Coopers and Syngenta.

The project is causing major strategic re-thinking among the 200 member companies in the World Business Council, and has generated thoughtful discussions in proceedings conducted by the United Nations, OECD, and a variety of academic institutions. That WBCSD has led the way on this project is especially significant given that its member companies have $7 trillion in annual revenues (comparison: China's GDP at current exchange rate is $5.8 trillion).

An important focus of the Report is to call out the urgency that is being felt by WBCSD member companies, and their concern that we must bring together many elements of global society to accomplish its objectives. The Report emphasizes the challenge of bringing together government, business, and NGOs to accomplish the very difficult 40 "must-haves " that the Report's analysis shows to be essential if we hope to be on track to achieve a sustainable 2050.

The World Business Council for Sustainable Development completed the Vision 2050 project in February of 2010. It stands as the most comprehensive set of milestones and one of the most plausible visions of the future of human civilization.

The two authors of the Report, Kreutzer and Zaidi, have joined with Stanford University professor of Biological Science, Paul Ehrlich, and Bob Horn, a visiting scholar at Stanford, to go beyond the WBCSD report. Here we try to summarize the strategic implications of the work done by the Vision 2050 project. What's especially significant about it is the clear indication that the companies in the WBSCD have achieved agreement on a new concept that represents a turning point – a way of thinking about our collective future in which business are prepared to commit themselves to be part of sustainable future. We think the identification of a critical 40 "must haves" to make that destination a real prospect is an extraordinary accomplishment. To fulfill its promise about the future, others will need to explore the clusters that represent key elements in each of those critical objectives – in short, supporting the new directions necessary for us to reach a sustainable 2050. This reminds us that we are now well into the year that marks the 20th anniversary of the Earth Summit in Rio in 1992.

The other major advance represented in this report is the way in which it brings together representatives of two major institutions in our civilization that often have been at odds with each other. Two of its authors represent the forward-looking business community; another, my colleague Paul Ehrlich, a spokesman for decades on the part of the scholarly community supporting environmental responsibility. These authors, among whom I am proud to count myself, agree that there is a singular need for diverse institutions in our civilization to do the urgent work of confronting climate change, social inertia, and the other challenges that confront the prospect of sustainability.

We are pleased to make this report the first in the series that the Millennium Alliance for Humanity and the Biosphere (MAHB) will be producing. We hope that it will inspire representatives of governments, academic institutions, non-government organizations and business communities to work together in more fruitful ways to accomplish the 40 must-haves.

Don Kennedy

President emeritus , Stanford University,

THE MUST HAVES FOR A SUSTAINABLE 2050

Mohammad Zaidi (Executive Vice President and Chief Technical Officer, Alcoa), Idar Kreutzer (CEO, Storebrand), Robert E. Horn *(Stanford University),* and *Paul Ehrlich (Stanford University)*

Winston Churchill once said, "It's not enough that we do our best; sometimes we have to do what's required."

Humanity, now approaching the twentieth anniversary of the 1992 *Rio Earth Summit,* is facing a tidal wave of ecological crises and financial disruptions as well as a few modest successes – while doing the best we can.

And, so far, what has the "best we can" resulted in? Our "best to date" has seen continuing global reduction in poverty increasing life spans and overall improvements in standards of living around the world. However this has come at a significant ecological expense – one that is clearly not sustainable. According to the global footprint network system of accounts, we are using one planet and a half's worth of ecological regenerative capacity. We are heading toward using two planets worth by 2030. And according to an article in *Nature*, three of ten critical planetary boundaries have been crossed and we are dangerously close to passing four of the other seven.

Will Rio change this trajectory? Not likely, as currently conceived. Global summits now run on a ritual of too many speeches and ending with blandly worded "agreements." The next Rio summit appears to the following that routine, even though the first Rio was a considerable success, resulting in United Nations Framework Convention on Climate Change treaty and several other major agreements**.** This ritual diplomatic dance reflects the current equilibrium of conflicting interests of nations of the world constrained by their domestic political priorities and lacking effective governance institutions for generating global action. NGOs have sometimes managed to get some broader interests of civil society common to people of many countries onto the agenda, but only rarely has that produced enduring results.

One recent, and little recognized, step in the effort to understand what would be needed to reach a sustainable future is a project of World Business Council for Sustainable Development (WBCSD), 200 of the biggest transnational corporations. It calls the world's attention to what they call "the 40 must-haves" that are "required [in this decade] for the world to be on track for a sustainable 2050." This is a hard-headed look by the senior strategists of 29 member-companies of the WBCSD. The

must-haves could provide a different kind of framework for making the Rio Earth Summit a genuine success and enabling humanity to do what is required. (see wbcsd.org for details)

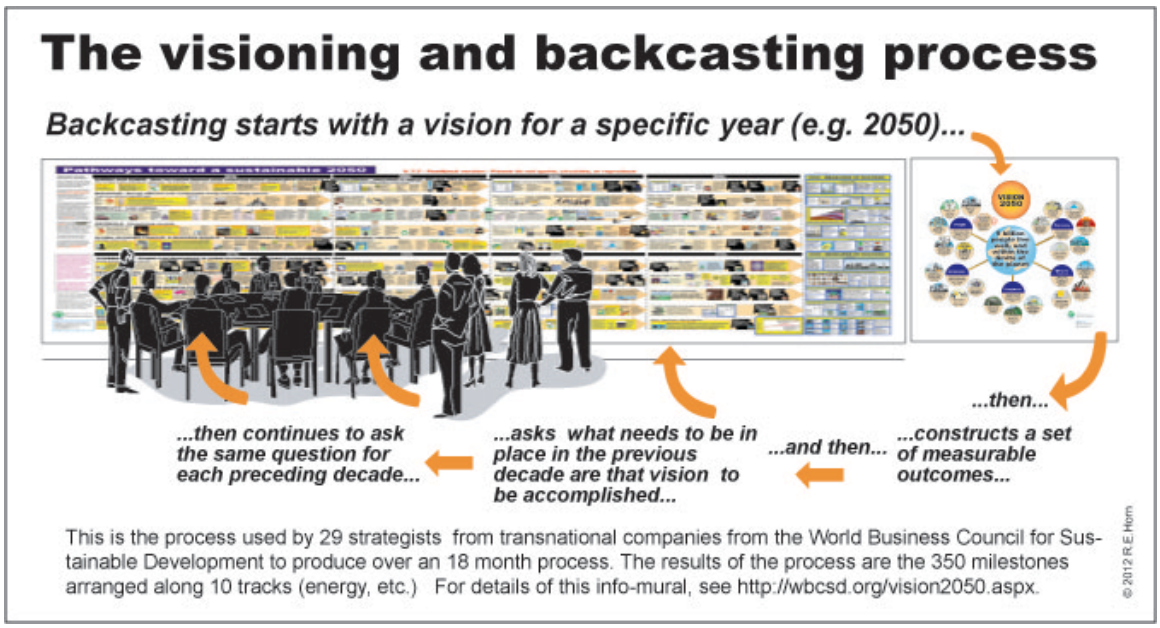
But the next Rio could be different because these "must-haves" convey a real sense of urgency and indicate that a major sector of global civilization, business, understands, and is willing to help a rapid transition toward a sustainable society. This message comes from a growing realization that few businesses can prosper in an environment that is deteriorating and societies that are disintegrating. This framework of must-haves is signaling the beginning of a major shift in strategy and priorities for many companies, and will influence how governments shape their strategies.

Producing the strategic must-haves for the next decade

Strategically, what action would it take to galvanize a world weary of such business-as-usual focusing on what everybody (else) "should be doing?" For one thing a rough set of requirements and the ability to measure progress against them and, for another, a way of seeing milestones on the way to reaching the requirements. And, finally, a group of perhaps 1000 leaders inspired by those must-haves and determined that we should achieve them.

How would one create a set of must-haves for the whole world? One way is to backcast – a reverse of forecasting that involves starting with a future outcome and working backwards to the present to see what steps would be required to reach that vision. Thus, to begin, one would devise a statement of what a sustainable world look like. Perhaps it would have a summarizing vision like: "Nine billion people live well, and within the limits of the planet."

If the team doing this is from the business world, they would then identify the measures of success, quantitative and qualitative that would tell you if the world were making progress and if you had arrived where you intended to be at each step.



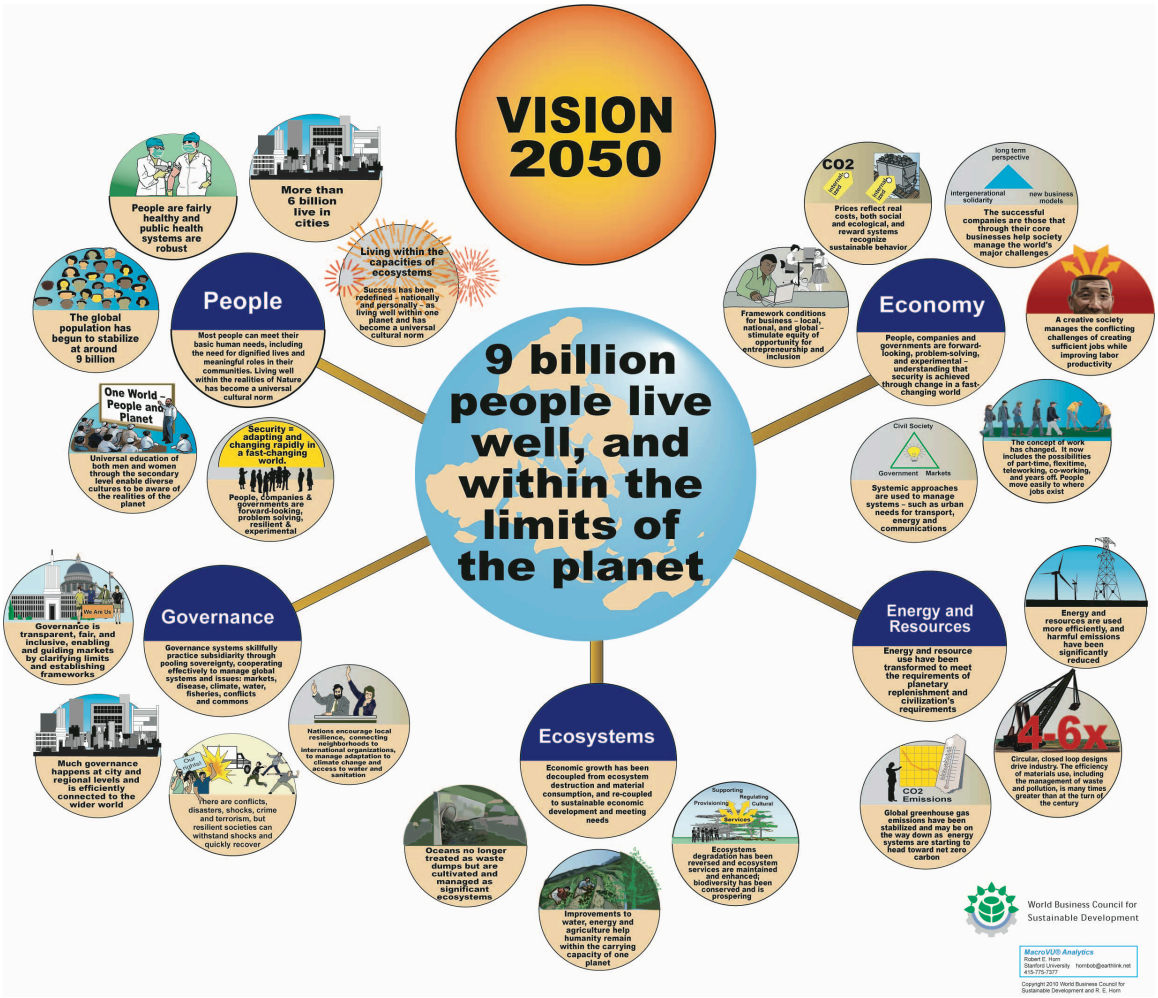
It would also be good to make a set of explicit assumptions to underpin the next part of the process. Such assumptions might include: Use the median UN Population Bureau forecast of 9 billion people on the planet in 2050. Don't use any assumptions about technology that cannot be counted on (e.g. nuclear fusion). Assume that cities will contain up to three-quarters of the people living on the planet. Use the most recent International Energy Agency scenario for power allocations. Assume that there will be little or no new cropland or water.

One can disagree with any such set of assumptions. And, of course, different assumptions would unfold a different picture of the future. But suppose what you wanted to create was a "standard world" or "reference" case with which other scenarios could be compared. Then you would use these fairly standard assumptions as a baseline.

From the measures and the assumptions, the task force would work backwards asking: To meet these measures of success, what needs to be in place in the 2040s? Then similarly you would work backwards with the same question for the 2030s, 2020s, and 2010s. The team would use the best research and the best judgment of specialists in their industries. This would give you a set of approximate milestones. To be comprehensive, the milestones might be analyzed along ten tracks (energy, mobility, buildings, forests, agriculture, governance, materials, people, ecosystems, economy). Finally, you would ask if there were some of the milestones that must be met in each decade – or the world just wouldn't be sustainable in 2050. These essential milestones you would name the must-haves.

This is the process a team of CEOs and senior strategists from 29 transnational companies used recently over an 18-month period. They created a vision statement of 22 elements outlining a sustainable world. It's a world most would like to live in,

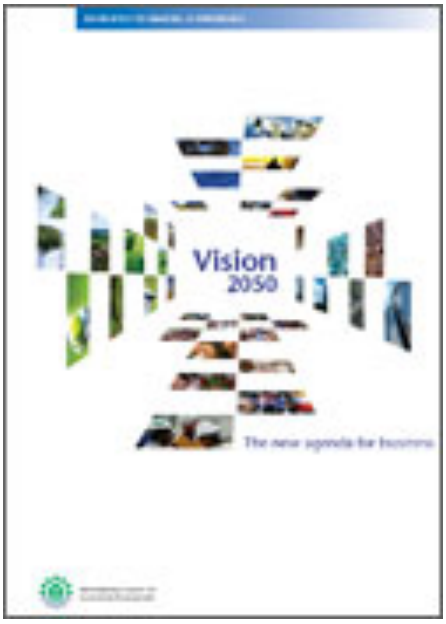
maybe somewhat more optimistic than many forecasts for 2050. It will obviously be difficult to achieve, but it was realistic enough for the WBCSD companies to sign off on.



They then created a relatively comprehensive set of 70 measures of success for 2050 (see sidebar or website). From there, they backcasted 350 milestones along the ten tracks mentioned above. Then, they identified 40 of these milestones as "must-haves" required to be on track in the decade of the 2010s for a sustainable 2050. They also used risk management methods to identify and assess the key risks. It is the most comprehensive, detailed, and realistic set of requirements to be found anywhere.

This process, of course, differs significantly from the usual way of creating scenarios in business planning made prominent by the successes of the scenario unit at Royal Dutch Shell. Such scenario-making processes always provide a minimum two and usually three or more imaginative narratives of how the future that might unfold. By contrast the backcasting approach gives you one set of requirements to achieve.

It is neither a forecast (what will-probably-happen), nor a scenario (what might-possibly-happen). A backcast is a must-happen-if-that-is-where-you-want-to-go.



Business involvement in sustainability

The modern business approach to sustainability began well before the first Rio Earth Summit 1992. Maurice Strong, a Canadian businessman turned UN executive, was the chief organizer of the conference, putting together a meeting that had 172 governments and 108 heads of state, huge groups of NGOs, and a major representation from business. WBCSD also was founded and made a major contribution to that meeting. Member companies of WBCSD are now drawn from more than 30 countries and 20 major industrial sectors. Together they serve more than 4,5 billion customers, and have a turnover that if it is put together would make it the second biggest economy in the world. The Council also benefits from a global network of some 60 national and regional business councils and regional partners.

The WBCSD member companies recognize that the global challenges we are facing will fundamentally change the framework for doing business. It will affect customer behavior, cost of capital, cost and access to raw material, and the regulatory framework. Business will have to manage new risks and form new partnerships. As a consequence the member companies focus on the strategic impact of a changing world, and try to be a part of the solution by intelligently capturing the business opportunities that these changes represent.

The must-haves

The vision for 2050 and the must-haves will require a major transformation in the way the world gets its goods and services; how its common areas are managed; and how its common areas are used and paid for. The effort builds on previous projects to set goals and assess progress, such as the Millennium Ecosystem Assessment and the Millennium Development Goals.

Some examples of the 40 must-haves include educating women to shift fertility rates to around replacement levels or below, and ramping up programs to preserve biodiversity in order to maintain the ecosystem services critical to sustainability. They include improving new vehicle carbon intensity by 30 – 40 percent; improving material throughput in manufacturing by 4 to 10 times; and meeting the increasing demand for energy while stabilizing climate change. Other must-haves were summarized as:

- Incorporating the cost of externalities, starting with carbon, ecosystem services and water
- Doubling of agricultural output without increasing the amount of land or water used, which implies a 2-3% increase in productivity per year
- Halting deforestation and increasing yields from planted forests
- Halving carbon emissions worldwide (based on 2005 levels) by 2050, with greenhouse gas emissions peaking around 2020 through a shift to low-carbon energy systems and highly improved demand-side energy efficiency
- Providing universal access to mobility not based on fossil fuels
- Delivering a four-to-tenfold improvement in the use of resources and materials.

The individual, detailed must-haves exhibit considerable diversity. For example, one must-have involves putting a price on ecosystem services by 2020. This will require a massive change in global business and government accounting systems. Similarly, doubling agricultural output is doable based on observed productivity gains in Europe and the US, but is a gigantic task of research, development, retraining of hundreds of millions of farmers, and revising continent-wide planting and harvesting practices. And improving the use of resources and materials by four-to-ten times will require re-engineering of most industrial infrastructure and manufacturing processes. (for a full list of must-haves, see website, or possibly, a sidebar)

Why this list, and how does it differ from the myriad of other lists of goals and targets produced by other task forces over the last 30 years? Two reasons: one, this list has been produced by business and it has considerable depth of support in the global business community. Two, the version of the must-haves presented on the large WBCSD mural is crisp, sharp-edged, and frequently quantitative. (see http://zoom.it/foTF)

Contrast those examples with the vagueness of one recent report that suggests African agricultural goals as follows: "The objectives of this programme area are: (a) To improve farm productivity in a sustainable manner, as well as to increase diversification, efficiency, food security and rural incomes, while ensuring that risks to the ecosystem are minimized." The comparable must-have from the WBCSD strategists says bluntly: Within the decade of the 2030s, "required to be on track for a sustainable 2050, African agricultural yield improves by a factor of five."

What is abundantly clear is that many of the must-haves are projects on the scale of going to the moon and back. And, the must-haves exist in a world where nobody is in charge. The urgency is that major parts of these efforts need to be accomplished in this decade, of which only nine years remain.

Failure on an individual must-have level can have ripple effects, preventing the achievement of other must-haves, and, thus, casting doubt on whether it is possible to reach the 2050 milestones. For example, geopolitical conflicts can derail many of the must-haves. The must-haves approach is flexible because it only states requirements. Requirements are not yet goals. Requirements are challenges, while goals have to be adopted with determination and courage. There is an obvious need to maintain flexibility; to report regularly on the measures of success; and to revise the must-haves as new situations develop.

It may seem that the WBCSD strategy team were looking at the world through proverbial rose-tinted glasses. We do not think so. Their reasoning indicates that nothing in the report is guaranteed. Rather, they list some 50 Big Risks that must be avoided if the must-haves are to be accomplished. (see website for list) They say: "There is little historical precedent for carrying through such a transformation so peaceably, swiftly and successfully as implied in Vision 2050, which is a transformation of massive proportions in the way 9 billion people live on the planet. As Vision 2050 demands that great changes take place in all areas, risks abound."

We know that with appropriate incentives truly immense transformations are possible. For example, in 1941 the U.S. produced 3,779,682 passenger cars, and then rapidly switched to production of equipment for the military. U.S. war production between 1942 and 1945 consisted of some 325,000 military aircraft, 88,000 tanks, 240,000 military trucks, 22 aircraft carriers, 8 battleships, 2,580 Liberty Ships, 250,000 artillery pieces, 287,000 machine guns, and three atomic bombs. This was done while rationing meat, gasoline, sugar, and other consumables and suffering almost a million casualties. Then at the end of the war in 1946 it produced 2,148,699 cars and by 1948 automobile production was greatly exceeding pre-war volumes. These stunning shifts in production and consumption occurred in the remarkably short time of four to five years. Industrial and social transformations in Great Britain, Germany, and Japan due to the war were similarly spectacular. For instance, the Japanese had to virtually recreate its machine tool industry anew when at the beginning of the war they found themselves heavily dependent on imports from the U.S.

What the WBCSD strategy team did *not* address in depth were the vital implementation processes, the interactions among the pathways, and the required institution building (and repairing), and the changes in human behavior that will be necessary. The Millennium Assessment of Human Behavior (MAHB) group at Stanford University is beginning an evaluation especially focused on the people, governance, and ecosystems must-haves, and will look especially at interactions among them. The WBCSD report also did not deal adequately with the dilemmas, contradictions, paradoxes and competing interests that deeply complicate implementation of the 40 must-haves and the other 300 milestones. Nor did it deal with the potential geopolitical issues that could derail even the best-intentioned and well-managed transition. Determining how to understand these and other obstacles are among the next intellectual and policy tasks that must be addressed. It is, however, encouraging to recognize that work on a few of the 40 must-haves is already well underway. For example, putting the price of ecosystem services into national accounts is already being explored in a pilot project led by the World Bank in India and Columbia. But in the world at large, governments and much of the business community in particular, have not as yet digested the scale and urgency of what the WBCSD strategists have pointed out. That, too, remains a major strategic and implementation challenge, one that the MAHB initiative hopes to help implement internationally.

Disagreements from various points of view

One of the important things to notice about the *Vision 2050* project is that it is a composite of ideas from the business sector and from environmentalists. Long-time environmentalists will see in the report many of the ideas they have promoted for decades being adopted by this sector of the business community, ideas such as payment for using ecosystem services, currently mostly unaccounted for by conventional economic theories and accounting practices. Recognizing the imminent shortages in many minerals and materials, the project also supports milestones for achieving massive, nearly complete, recycling by the 2040s (a process that will involve huge research, and redesign, and massive infrastructure rebuilding). On the other hand, there are elements of the report that some environmentalists have strongly opposed. For example, the project supports, or at least assumes, that more nuclear power will be part of the energy solutions; that modest advances will be made in developing genetically modified crops; and will be deployed, and that everyone has a basic need for mobility. The must-haves, thus, cut both ways. To us, this means that the business strategists were relatively straight-forward in constructing the requirements. What it also says is that to accomplish what must be done, those two previous antagonists, business and environmentalism, are understanding each other better and beginning to increase their cooperation. Many cross-sector trust-building relationships need to be built. The struggle to define the needed adjustments to standard concepts of industrial capitalism will be one of the more difficult tasks.

It is worth noting that the WBCSD is only part of the global business community. It is a CEO-led membership organization of 200 transnational corporations that endorse sustainability ideas. Any project, such as Vision 2050, must be led by at least one CEO of a member company. That means that the initiatives reach the highest levels of the corporate world. It is remarkable and encouraging that a significant segment of the business community has begun to step into the global leadership gap on sustainability, as many are discouraged at the inability of governments to agree on basic elements of sustainability, such as joint efforts to address greenhouse warming.

The task force team in their deliberations frequently called their approach business-as-(UN)-usual and that they believe its main value is contrasting this with the business-as-usual world. As their report says: "The participating companies strongly believe that the world already has the knowledge, science, technologies, skills and financial resources needed to achieve Vision 2050 but the foundations for much of what is required will need to be laid at speed and scale in the next decade." Breakthrough technologies will occur, but were not assumed in creating the back casting assumptions. The same can be said for unexpected problems, which can be absolutely guaranteed when dealing with a complex adaptive system such as the combined socio-economic and biospheric systems now constitutes. This means that business and government planners have a platform, a standard reference case to develop other less standard scenarios, and to plan for and trigger responses to the unexpected.

Emerging new strategy

The 40 must-haves are basically a call to action originating in the business community based on decades of work by academia, environmental NGOs, and governments. How should the world respond?

A new, as yet unnamed, and not fully developed strategic viewpoint appears to be emerging among many of the major players in sustainability and climate change, including governments, many transnational corporations, and emerging programs such as the MAHB initiative.

Many companies have been moving ahead with major strategic changes as well as significant tactical changes such as energy efficiency initiatives that immediately save them money. Some of these strategic changes, for example, have to do with location of manufacturing plants based on the assumption that there will be severe water shortages and on resilience of long supply chains.

Significant initiatives in agriculture have been undertaken. For example Unilever has been participating in a "sustainable agriculture lab" for the past seven years. It

has committed to making its supply chain for agricultural products sustainable by 2020. Similar initiatives have been started by Walmart, Pepsi, Coca-Cola, GE, Ford, Toyota, and many other companies.

What this means is that initiatives relevant to the 40 must-haves have begun. These include how to organize and facilitate large multi-stakeholder, multi-national, multidisciplinary, and multi-worldview groups representing major organizations and large transnational corporations. This "multi-multi" facilitation and organization skill is something that will be in great demand in the next five years. It represents a new kind of leadership, one that is little taught in business schools or elsewhere in universities.

What other kind of signals do we see? Even some of the difficult, so-called elephants in the room, are being attended to. Elinor Ostrom, who won the Nobel prize for economics in 2009, with her work on the dilemma of the tragedy of the commons, has been formulating a "polycentric" governance responses to common pool resources. These are the global commons, such as atmosphere, oceans, drainage systems, forests, and other shared resources. One significant movement in this area is a study of new domestic legislation on climate change among 16 major emitters, all of whom have passed significant domestic legislation on climate change in the past year and a half. The report says: "This demonstrates that the shape of the debate is changing from one about sharing a global burden – with governments naturally trying to minimize their share – to one of a realization that acting on climate change is in the national interest … It is particularly encouraging that the large developing countries of Brazil, China, India, Mexico and South Africa – who together represent the engine of global economic growth – are developing comprehensive laws to tackle climate change."

Many of the must-haves depend to some degree or, indeed a great degree, on government action. Business leaders will need to change the way they manage government relations. The function of vice president for government relations in Brussels and Washington will change. They will need to learn how to represent a long-range, stable future for investment, and avoid blocking policies needed for greater societal resilience. This will be a whole new role, and will certainly involve considerable coordination, deliberation, negotiation, and speaking to government with a single voice, a voice that echoes what the future has been saying to business. How government and business can work together for this kind of future will require both business executives and government officials to get to know each other better in order to build the necessary trust that will enable progress to be made in the turbulent times ahead.

Three silos – geopolitics, sustainability, and business

As one reads this journal and attended conferences over the past decades, it was easy to conclude that completely different strategic communities existed for geopolitics and for environmental sustainability. The communities of geopolitics and of sustainability existed in the same world, but in separate silos and rarely communicated.

The two strategic communities, geopolitical and environmental, envisioned different non-overlapping futures. Those within the geopolitical strategy silo focused on power first and foremost. It has been based on economic power and demographic size from which flowed political and military power and regional hegemony. Its strategic investments were conceived of as manufacturing plants and military forces. The strategic silo of sustainability was nature-based and science-based. It reckoned with the importance of natural capital. It discussed tropical forests, water, food production, and pollution. It came to emphasize climate change and the need for massive investments in mitigation and adaptation. It began to conceive of incorporating the true price of ecosystem services in national and company accounts. These two silos have recently begun to come together as a strategic theme of future thinking. Jointly they, for example, foresee major military conflicts, even nuclear wars, resulting from disputes over scarce resources and massive disruption from climate disruption.

But the strategic discussions continue to take place in different venues, in different parts of campuses, and in different think tanks. Business, while it delivers much of the goods and services people want, has largely stood on the sidelines of either of these discussions. It was as if business existed outside of either of the silos.

But something different is beginning to happen. Business is starting to adopt a strategy of Big Transformation, in part because it is listening to the voice of the future. It contains the realization of the constraints, increasingly precise, within which business strategy, and indeed national and international strategy will take place. Thus, many business decisions are now being made to get ahead of the risks and to capitalize on the opportunities portrayed by these approaches.

The Vision 2050 project identified several areas where significant funds need to be invested – starting now. Just in the field of urban infrastructure-investments estimates show that 40 trillion USD will be needed by 2030, of which 22 trillion USD in water infrastructure alone. Private sector capital is seen as a likely larger contributor than public funds, and more so as several nations cannot tap the fixed income markets as easily as before. One of the natural sources of private sector capital – and one of the largest pools of funds - is pension funds and insurance companies with “long money”, matching the long life span of infrastructure. These funds also seek long and stable cash flows of high quality. All of this as well as inflation adjustments are most often found in infrastructure. But only small amounts of pension capital have so far been invested. Studies recently undertaken by the OECD point to a number of challenges in this regard. Lack of transparency, lack of knowledge, lack of appropriate investment vehicles and regulatory issues are all

identified as issues that need be addressed. These processes which are now led by some pension funds and the OECD, should be supported by all parties involved.

All this is happening even though many governments have not agreed on what to do about renewable energy or electricity grids, the incorporation of resilience into water-handling infrastructure, or the replacement of transportation infrastructure. Business strategists have begun to learn to listen to how a range of plausible futures is speaking to them. Of course, all is not clear in these scenarios. Pacing, scope and scale of transformation within foreseeable ranges are used to manage uncertainty and risk. And there is significant discomfort and anxiety as major economics and business assumptions are being challenged, particularly those about the possibility of unlimited growth (even in the next 15 years) in the global economy. The strategic struggle to define a roughly steady state economy and even more difficult, how to transition to such an economy, has just begun.

Making these kinds of changes portrayed in the pathway to Vision 2050 could enable us to get back to consuming around one planet's worth of renewable ecological resources in 2050, as opposed to the several planets we will be using if we continue on the business-as-usual path we are on today. The WBCSD conclusion is that it *can* be done. And Winston Churchill's conclusion is: " sometimes we have to do what's required."

Appendix A

The 40 Must-Haves for this Decade

Required to be on Track for a Sustainable 2050

ENERGY AND POWER - Meet increasing demand while stabilizing global temperature increase to 2 degrees Celsius – equivalent to approx. 450 ppm CO2 in atmosphere

1- Energy R&D increases rapidly

2- Major collection of international agreements on climate and energy Not necessarily treaties, but perhaps bilateral and multilateral agreements

-3 Carbon has a price - cap & trade or carbon tax begin to transform electric power generation Maybe through a comprehensive treaty or perhaps a series of multilateral agreements

4- Carbon sequestration funded for rapid deployment

5- Distorting energy subsidies phased out and increased international cooperation in deploying low-carbon technology occurs

6.

Approx. Milestones for staying below 2°C (average global temperature) **6**

Approx. Amount of Energy Infrastructure Built During 2010-2020 (World wide)

	Total by 2020	Units
Coal-fired with CCS	10	500 mw CCS plants
Gas-fired with CCS	5	500 mw CCS plants
Nuclear	80	1000 mw nuclear plants
Hydro	20	5000 mw dams
Biomass plants	50	50 mw biomass plants
Wind-onshore	40000	4 mw wind turbines
Wind-offshore	5000	4 mw wind turbines
Geothermal	200	100 mw geothermal units
Solar Photovoltaic	2000	50 mw installations
Concentrated Solar	300	250 mw installations

BUILDINGS - Energy efficient and comfortable living and working spaces

7- Energy Efficiency (Buildings and Appliances)
- Implementation of mandatory minimum efficiency performance standards
- Revisit international standards periodically to ensue continuous improvement
- No delays in legislation of strong regulations and enforcement is the most cost-effective policy

Key Areas of International Collaboration:
-Common standards set to discourage trade in sub efficient appliances.

MOBILITY - Low carbon

8-Development and deployment of efficient internal combustion vehicles improve new-vehicle carbon intensity up to 30-40%, enabled by better policies and introduction of Electric Vehicles (EV)/ Plug-in Hybrid Electric Vehicles (PHEV)

9- Integrated urban planning, especially in the fast-growing cities, improves transport and allows for more choice among appropriate modes

10-Transportation energy efficiency:
- Mandatory efficiency standards; eventually harmonized globally at highest efficiency level
- Incentives for new technology other than increasing size, weight or power
- Standards set for medium and heavy duty trucks (logistics, onroad

12- Policy makers and industry partner to speed up research into and deployment of alternative drivetrains and advanced biofuels

13- Integrated rail networks spread. Infrastructure investments keep up with growing demand of passenger and freight transport

14- Sustainable biofuels for aviation are fully tested and begin to be used
Governments help to ensure
- Sufficient and steady biofuel supply through early incentives
- Aviation is allocated necessary share of biofuel supply despite competition with other forms of transportation
- Cost does not exceed petroleum-based jet fuel

15- Vehicle users adopt more efficient driving behavior, stimulated through information campaigns

16- Improved energy efficiency in shipping is achieved through holistic approaches to transport chain performance

MATERIALS - Closed-loop society

17- Global business and governments agree on a set of indicators & rules for accounting about resources, energy and materials. These rules establish the true cost of primary and secondary materials.

18- New landfill legislation begins to set standards for recycling and reuse

19- Industrial-application Carbon Capture and Storage
-- Develop legal and regulatory frameworks, to include liability clarity for CO2
-- R&D to reduce capture costs, determine storage integrity, monitoring
-- Greater public awareness of benefits and cost

GLOBAL ECONOMY, FINANCE, & BUSINESS MODELS - Transform contemporary industrial capitalism into sustainable capitalism

20- Externalities internalized and investors incorporate rapidly new accounting standards into risk and opportunity decision-making. These accounting changes enable companies to measure both positive and negative impacts on ecosystem services

21- Global price on carbon internalizes major costs of CO2 and other emissions

22- Technology transfer for energy and some other areas such as food is successfully implemented. Collaboration between government leaders from major economies in both North and South lead to creation of a global venture capital fund to commercialize clean energy and food technologies. The fund licenses intellectual property and sells technology to countries on terms that vary according to their average per capita GDP. This is supported by concessional terms for developing countries (Or some other approach that is efficient and effective and meets same goals)

GOVERNANCE - Enable transformations in global economy and planetary sustainability by 2050

23- Major collection of international agreements on climate and energy Not necessarily treaties, but at minimum bilateral and multilateral agreements

The 40 Must-Haves for this Decade

Required to be on Track for a Sustainable 2050

24- A more effective summit of the Major Economies begins to meet on a quarterly basis Discusses existing and potential global challenges including security. G8 plus outreach 5: Brazil, China, India, South Africa and Mexico plus Indonesia, Turkey, Egypt or Nigeria.

-

PEOPLE: VALUES, BEHAVIORS, AND DEVELOPMENT - Well on the way to meeting basic needs of all people by 2050

25- Universal primary and secondary education has begun to shift fertility rates to around replacement levels. More women are educated and engaged in economic activities, leading to improved health of women and their children

26- Reproductive choice, contraception, family planning available virtually everywhere on the planet

AGRICULTURE - Feed 9 Billion People by 2050

27- To feed 9 billion people by 2050, food, feed, fibre, and fuel output must increase two-fold, growing 2% annually without increasing the negative environmental impact and if possible not use any more land for agriculture.

28- Asian, Pacific water efficiency doubles

29- Freer trade in agricultural products, in order to maximize production of food and agricultural products on a global scale

30- Wheat production doubles. World's second biggest crop in volume and represents the greatest challenge for reversing the trend of declining yield growth. Currently rate of yield gain in wheat has been falling faster than any other crop. New technologies, especially in Eastern Europe and Africa, reverse this decline

FOREST - Sufficient timber and fuel for 9 billion people by 2050 while reducing carbon emission significantly

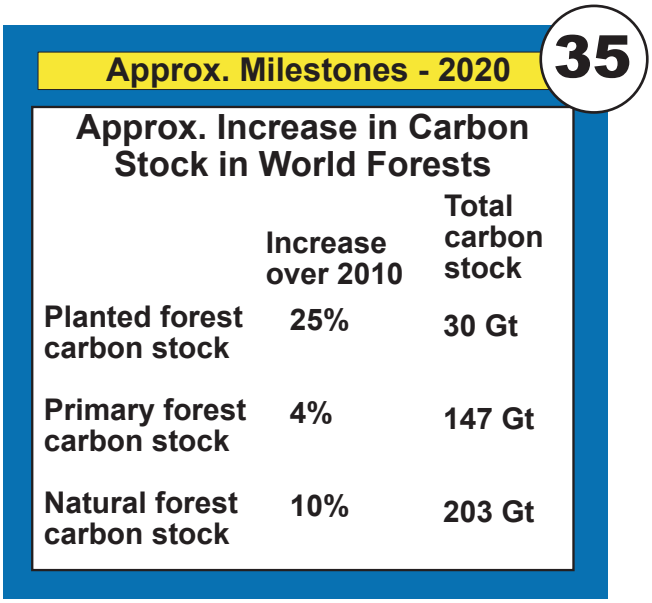
31- The United Nations Framework Convention on Climate Change (UNFCCC) releases the Reducing Emissions from Deforestation and forest Degradation (REDD) report. Without REDD, the 2 degree C climate stabilization goal will not be met

32- Commitments to deep carbon reductions by industrialized countries to create demand for REDD+ carbon credits.

33- Major actions addressed by REDD+ begin to be implemented:
- Provide financial incentives to local people for conservation and expansion of ecosystem services from primary and modified natural forests.
- Procedures for setting emissions levels
- Methodologies for monitoring, reporting and verification
- Processes to promote the participation of indigenous peoples and local communities

34- Shift production from modified natural forest to planted forest by tripling planted forest yields by 2050

35-



ECOSYSTEMS & BIODIVERSITY - Maintain and restore

36- Improved NATURAL LITERACY - Increased knowledge and attention on ecosystem services A range of in-depth and comprehensive multi-year studies have deepened our understanding of the functioning of the full range of ecosystem services. Widespread media attention of such studies has contributed to a greater focus on the protection and enhancement of ecosystem services.

37- Donor countries increase the investment in rural communities in and around protected areas to grow their economic base and reward biodiversity protection. This provides the kind of protection that the market can not provide alone

38- Business, NGOs, governments agree on ecosystem valuation methods including valuing the global commons (e.g. eco-services of oceans, forests, atmosphere, etc.

39-Seed banks and botanical gardens all over the world work closely together to preserve most of today's biodiversity

40-Fair pricing of ecosystem services

MacroVU® Analytics
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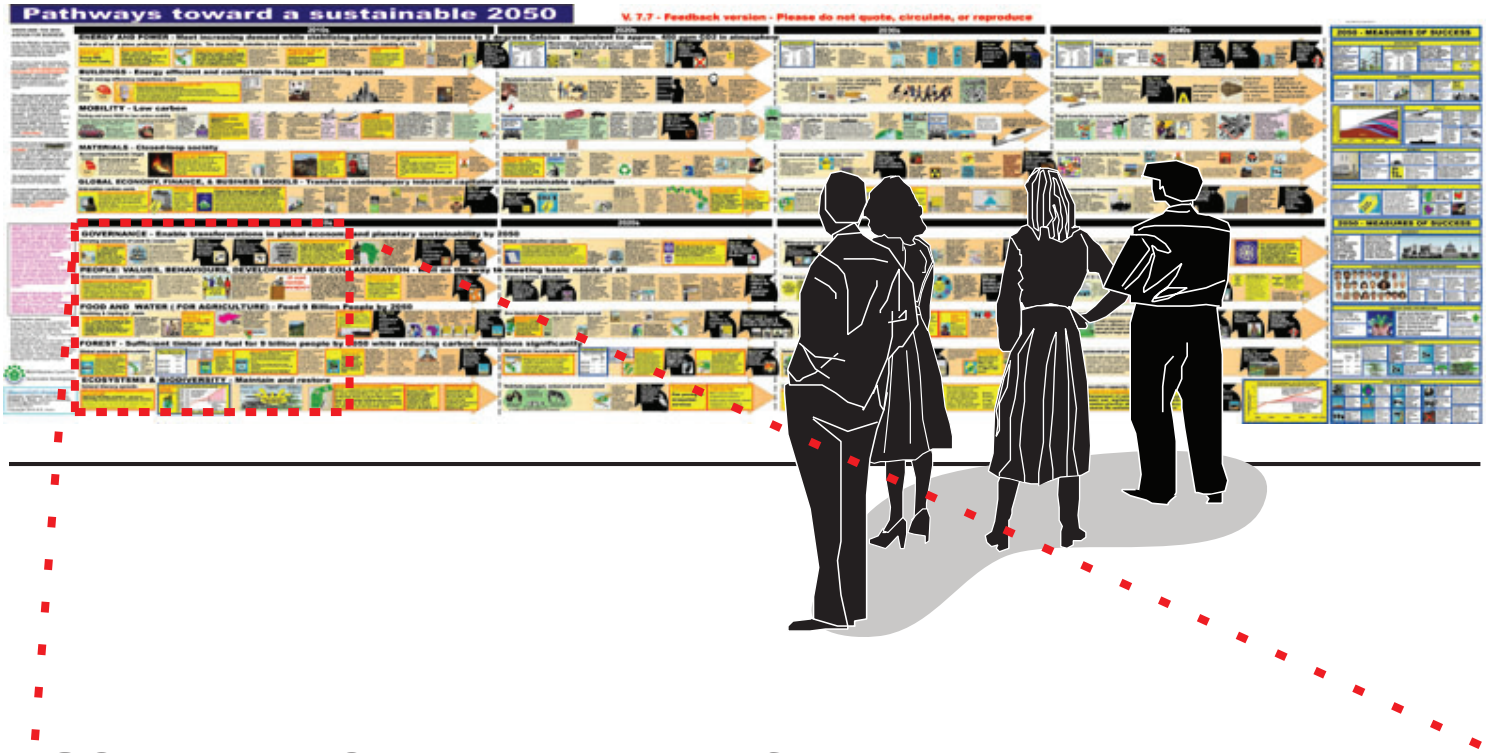
Appendix B

The World Business Council for Sustainable Development info-mural -

Pathway to a Sustainable 2050



GOVERNANCE - Enable transformations in global economy

Growing awareness of need to cooperate

Required to be on track for a sustainable 2050 **Major collection of international agreements on climate and energy** Not necessarily treaties, but at minimum bilateral and multilateral agreements

Global Issues Networks

International governance begins to shift from treaties to cooperative issue networks and more frequent trust-building summits and mini-summits *Representatives from governments, NGOs, UN and business collaborate on issues*

Big risk **International terrorism networks increase**

Big risk **Massive rise of international drug and crime organizations**

MAJOR ECONOMIES MEETING (MEM) summit meets often

Probably necessary for scenario to be "on track" for 2050 **A more effective summit of the Major Economies begins to meet on a quarterly basis Discusses existing and potential global challenges including security. G8 plus outreach 5: Brazil, China, India, South Africa and Mexico plus Indonesia, Turkey, Egypt or**

PEOPLE: VALUES, BEHAVIOURS, AND DEVELOPMENT -

Eco-awareness spreads rapidly

Required to be on track for a sustainable 2050 **Universal primary and secondary education has begun to shift fertility rates to around replacement levels. More women are educated and engaged in economic activities, leading to improved health of women and their children**

Eco-aware consumers lead selection of products, services, and leisure activities based on efficiency, ecological and social impacts, reinforcement of individual work-life balance, community needs, and global resilience

Sometime during this decade New "people and planet" movement leaders emerge. Many societal actors take responsibility for deeper "ecological-awareness education" to encourage changes in perceptions and behaviour by the end of the decade. New measures of personal success beyond financial status become more popular

AGRICULTURE - Feed 9 Billion People by 2050

Doubling & tripling of yields

Required to be on track for a sustainable 2050 **To feed 9 billion people by 2050, food, feed, fibre, and fuel output must increase two-fold, growing 2% annually without increasing the negative environmental impact and if possible not use any more land for agriculture.**

Assumption: Better use of freshwater. Most efficient way of increasing the efficiency of water use in agriculture is through increasing yields and requires extracting the maximum yield per drop.

Required to be on track for a sustainable 2050 **Asian, Pacific water efficiency doubles**

Russia & Ukraine triple wheat yield via professionalization of farming

With the successful completion of the WTO Doha round, large agricultural subsidies are discontinued boosting production in Latin America, Eastern Europe and Africa

2nd generation biofuels hit market. Cellulosics converted into biofuels greatly improves fuel efficiency, frees up cropland, alleviates food/fuel conflict, and diminishes carbon footprint

Increasing knowledge in agriculture continuously optimizes input efficiency. Farmers manage the landscape, and need technical support, access to capital, access to markets and information to build capacity for higher productivity and natural resource efficiency. Wide acceptance of existing technology.

FOREST - Sufficient timber and fuel for 9 billion people

Global action on deforestation

Required to be on track for a sustainable 2050 **The United Nations Framework Convention on Climate Change (UNFCCC) releases the Reducing Emissions from Deforestation and forest Degradation (REDD) report. Without REDD, the 2 degree C climate stabilization goal will not be met**

REDD+

Carbon storage benefits of wood products are recognized in carbon markets

Approx. Amount of Carbon Stock in World Forests	Total carbon stock
Planted forest carbon stock	24 Gt
Primary forest carbon stock	142 Gt
Natural forest carbon stock	185 Gt

Total amount of carbon storage in wood products	E.g. Global stock of carbon stored in wood in buildings, furniture, etc.
21 million tons	

REDD+ CO2

Probably necessary to be on track to a sustainable 2050 **Commitments to deep carbon reductions by industrialized countries to create demand for REDD+ carbon credits.**

REDD+ in Action

By the end of the decade **Major actions addressed by REDD+ begin to be implemented:**
- **Provide financial incentives to local people for conservation and expansion of ecosystem services from primary and modified natural forests.**
- **Procedures for setting emissions levels**
- **Methodologies for monitoring, reporting and verification**
- **Processes to promote the participation of indigenous peoples and local communities**

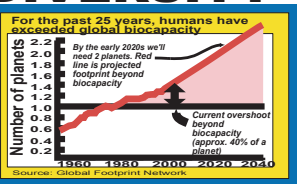
Increased demand for building materials and other wood products, forest biomass for power generation and fuel drives greater production.

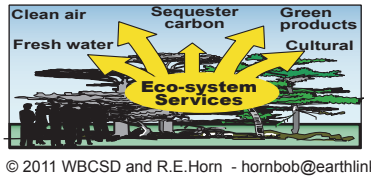
ECOSYSTEMS & BIODIVERSITY - Maintain and restore

Natural literacy spreads

This will take time, but is required to be on track for a sustainable 2050
Improved NATURAL LITERACY - Increased knowledge and attention on ecosystem services
A range of in-depth and comprehensive multi-year studies have deepened our understanding of the functioning of the full range of ecosystem services. Widespread media attention of such studies has contributed to a greater focus on the protection and enhancement of ecosystem services.

This is our current situation





Further Information

Vision 2050 Project Report
http://www.wbcsd.org/vision2050.aspx

To see the Pathway to a Sustainable 2050 mural on the internet:
http://zoom.it/foTF

Download the WBCSD pathway mural and vision poster:
Horn-WBCSD VISION 2050-Pathway mural
www.stanford.edu/~rhorn/e/uc-PathwaysMuralWBCSD.pdf

Horn-WBCSD-The Vision of a sustainable 2050 mural-poster
www.stanford.edu/~rhorn/e/WBCSD-VISION-2050.pdf

If you want to order a full size printed and laminated copy of the WBCSD pathway mural and vision poster contact Ruben Nelson, Foresight Canada.
RubenNelson@shaw.ca
They will print and send it to any place in the world.

References

World Business Council For Sustainable Development (2010) , Vision 2050, The New Agenda for Business, Geneva, **http://www.wbcsd.org/vision2050.aspx**

Horn, R. E. (2010) Engaging the 40 Must Haves in a Nobody in Charge World
www.macrovu.com/bfng-BobHorn-WBCSD-40-MUST-HAVES8.3.ppt

Horn, R.E. (2011) To save the planet, listen to everyone, New Scientist, Dec. 17, 2011, 28-29.

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